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ABSTRACT

This study sought to identify relationships between selected teacher cognitive verbal behaviors and the residual class mean gain achievement scores on a test designed to measure the attainment of instructional goals. The criteria measure was a 38-item true-false test used for both pre- and post-testing of student comprehension. Twenty preservice teachers and two experienced teachers comprised the sample. Each teacher conducted two 45-minute lessons on the economic concept of specialization with a randomly selected group of 15 students. Lessons were audio-taped and later analyzed. Select student behaviors during instruction were also measured. Seven hypotheses were derived from the results of this study: student learning and achievement will increase (1) as teacher behavior during concept instruction becomes more structured and task relevant; (2) as the substantive aspect of teacher behavior becomes more adequate, accurate, and relevant to the instructional objectives; (3) as teachers include more of the relevant knowledge generalizations and the relevant concept labels during concept instruction; (4) as teachers express more enthusiasm and interest; (5) as teachers ask more questions specifically requesting that students provide concept-relevant behaviors such as defining and exemplifying; (6) as student involvement in concept-relevant tasks such as the giving of concept examples and definitions during instruction increase; and (7) as student task-relevant initiated behaviors increase during concept instruction. (MM)

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# Teacher Behavior and Effective Teaching of Concepts

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Teaching Behavior and Effective
Teaching of Concepts

Through research on the nature of instructional environments, it is hoped that hypotheses about the relationships of teaching performances to student learning may be developed. One way of defining a learning environment is in terms of the behavioral characteristics of its participants. The reasoning underlying this emphasis is that the dominant features of an environment depend upon the typical characteristics of its members and that certain environments tend to reinforce or to extinguish specific behaviors. It is assumed that instructional environments differ in the particular behaviors they reinforce and thus tend to produce differential effects in terms of the nature, quantity, and quality of student outcomes.

It is being hypothesized here that optimal learning environments differ according to the nature of the anticipated student outcomes. Sub-environments, which are highly dissimilar, may exist, even within one classroom. These varying settings may serve to reinforce differing learning outcomes. It is conceivable, for example, that a sub-environment which reinforces divergent, creative thought processes may not promote the learning of specific facts and generalizations.

One of the tasks of investigators who attempt to identify optimal learning environments is the determination of relevant aspects of sub-environments which are likely to reinforce specific behavioral outcomes. In this connection, the need for a taxonomy of <u>situations</u> and <u>learner outcomes</u> is apparent. One might ask:

(a) What are the basic categories of school goals (such as concept and generalization learning, the development of divergent thinking skills, the development of problem creation and solution skills)?

(b) Are there identifiable sub-environments which optimally promote such learner outcomes?

Needless to say, such a taxonomy does not exist. We continue to view school learning in terms of subject matter goals rather than in terms of general skills, abilities, and attitudes which are supported by the various academic disciplines. Most process-product research efforts are conducted in the context of describing teaching as it occurs within subject matter parameters with little attention being given to the types of learning or student achievement being promoted or even to the teacher's intent, as reflected in course or instructional objectives.

Gage (1963) and Rosenshine and Furst (1971) have urged teacher behavior investigators to conduct studies such as those being suggested here, in which specifically defined aspects of teacher behavior are examined. Such micro-effectiveness studies could examine teacher and student behaviors in terms of instructional intent, as reflected through statements of objectives. It may be useful to concentrate some process-product research efforts around categories of student achievement in order to investigate possible treatment by outcome relationships.

One category of student outcome is that of concept learning. The study reported here is one in a projected series of investigations aimed at identifying and validating the characteristics of classroom sub-environments which promote optimum levels of concept learning. One long-term goal of this research is to test the generalizability of optimum concept learning sub-environments across types of learners and across subject matter.

Summary of the Investigation

This study was primarily an exploratory, correlational investigation. The aim was to identify relattionships between selected teacher cognitive verbal

behaviors and the residual class mean gain achievement scores on a test designed to measure the attainment of the instructional goals. The criteria measure was a thirty-eight item true-false test on the economic concept specialization; pre- and post- instructional data on student comprehension of the concept were collected by means of this instrument. The criterion measure was defined by computing the regression of posttest score on pretest score across the entire group of students, and aggregating individual student change scores over each class.

Twenty preservice teachers and two experienced teachers comprised the sample. Each of the twenty-two teachers conducted two forty-five minute lessons on the economic concept specialization with a randomly selected group of fifteen students from within each class. Third, fourth, and fifth grade elementary school students (n=288) participated in the study. Lessons were audio-taped and later analyzed by two trained observers.

Two weeks prior to pretesting students, the teachers met with the investigator for an orientation session. While a general explanation of the study was provided, no mention was made of the particular categories of teacher behavior of interest to the investigation. One week before pretesting, teachers received a list of the randomly selected children in the class who constituted the instructional group. At this time also, each teacher received an Instructions for Teacher manual. This manual included instructional objectives for the two lessons on the economic concept of specialization, background substantive information on the concept, and a set of procedures intended to facilitate organizational matters in the data collection process. Teachers were aware that students would be tested on items constructed to be congruent with the instructional objectives; however, at no time did the teachers know the actual test items.

The instructional objectives called for the student to be able to identify examples and nonexamples of the concept specialization in its three forms --

occupational, technological, and geogrsphical; to relate specialization to the concepts of interdependence and trade; and to be able to identify examples of problems associated with specialization.

Four five-day research sequences were identified, extending over a two-week period. Each sequence consisted of five parts: (a) pretesting; (b) "resting" for two days; (c) conducting the first concept lesson; (d) conducting the second concept lesson; and (e) posttesting.

Pre- and post-testing sessions were conducted by the investigator and/or trained assistants, with all teachers absent from the classroom. Each student had a copy of the test items and an answer form; each item was read aloud by the test administrator to minimize the interference of irrelevant reading problems.

On each of the consecutive fourth and fifth days of the research sequence, each teacher conducted a discussion-type lesson on specialization with the randomly assigned class group. Lessons were audio-taped by the teacher; class groups were posttested by the investigator within one hour following the end of the second lesson.

Three instruments were developed to facilitate the quantification of the teacher and student process variables. An acceptable level of coder agreement was achieved for each instrument. The Observational System for Concept Instruction (OSCI) was employed to record the low inference teacher strategic behaviors and the student process behaviors. Teacher and student behaviors were recorded sequentially on the OSCI, but were averaged across each variable category for purposes of statistical analysis. A tally form was used to assess the adequacy of the teacher's content coverage and concept label coverage. High inference ratings were recorded on a rating form.

The total frequencies for each teacher and student variable were averaged over the two lessons. Pearson product moment correlation coefficients tested the stre

strength of the relationships between the variables. (See Armento, Journal of Teacher Education, 1977 for further information on basic procedures for the study.)

Identifying Relevant Teacher Variables

Given the lack of a theory or conceptual model of teaching from which to select behaviors, the task of identifying relevant teacher and student process variables is the first critical step in the effort to collect valid and reliable data on the teaching act. Selected independent variables serve as hypotheses regarding which behaviors are likely to occur during concept instruction and which are likely to be relevant to student concept learning. Two basic assumptions guided the selection of relevant behaviors for this study.

(1) Teacher behavior should be examined in terms of intent. Intent may be derived from instructional objectives.

(2) Relevant process variables should be derived from existing theoretical or empirical bases which provide support for expecting certain relationships between instructional behavior and student outcomes.

The variables in this study were derived from previous process-product investigations and from experimental studies of concept learning. The focus was on the verbal cognitive aspect of the teacher's task rather than on all possible dimensions.

The generation of particular teacher process variables was facilitated by asking the question: What are the characteristics of a concept instructional event which relate logically to clear, effective instruction? This question was answered as follows. In preparation for a concept instructional sequence, a teacher must respond to at least three pragmatic concerns.

(1) What particular knowledge is needed to achieve the instructional objectives? This question refers to the substantive aspect of instruction.

(2) What terminology ought to be employed to transmit meaningful ideas most effectively to learners? This question refers to the semantic aspect of instruction.

(3) What particular logical, procedural moves ought to be made during the lesson to meet the instructional objectives most effectively? This question refers to the strategic aspect of instruction.

Substantive, semantic, and strategic components of instruction served as major categories for the generation of teacher antecedent and process variables. Following is a brief explanation of each instructional component along with the names of the variables employed in each category.

Substantive variables. The substantive aspect of an instructional event refers to the body of knowledge explicitly made available to students during the lesson. In a primarily discussion-mode lesson, much knowledge is made available through teacher discourse or explanation. Scriven (1959) suggests the three criteria of accuracy, adequacy, and relevance for satisfactory explanations. These three criteria can aid in the identification of relevant antecedent as well as process variables. Three antecedent questions are:

(1) How accurate is the teacher's knowledge (of the relevant subject)?

(2) How adequate or complete is the teacher's knowledge of the subject? and

(3) Is the knowledge which the teacher is able to generate relevant to the knowledge demanded by the specific instructional objectives?

Five variables related to the substantive aspect of instruction were employed in this study:

Accuracy (1) The concept definitions given or developed by the teacher are accurate.

(2) The concept examples given or accepted by the teacher accurately represent the concept.

Adequacy (1) The teacher explicitly states the necessary knowledge components (as implied by the instructional objectives).

(2) The teacher explicitly states the necessary concept labels or names (as implied by the instructional objectives).

Relevance (1) The teacher's verbal behavior is appropriate to the achievement of the instructional objectives for the lesson.

Substantiation for the accuracy, adequacy, and relevance variables can be found both in previous process-product investigations and in concept learning studies. Positive relationships have been found between the variable "opportunity to learn the criterion material" and student performance. The "opportunity to learn" variable is similar to the adequacy and relevance variables employed in this study. Rosenshine (1972), Shutes (1969), and Husen (1967) found significant positive correlations between measures of opportunity to learn and student achievement. In both the Rosenshine and Shutes studies, actual tape-scripts of lessons were assessed to determine the extent of content coverage. In Husen's study, teachers rated whether their students had the opportunity to learn the type of problem(s) represented by the test items.

An important aspect of concept instruction is that the concept examples illustrate the critical dimensions of the concept. Experimental investigations on concept learning support the principle that as the critical properties of the concept become more obvious, ease of concept attainment increases (Clark, 1971). Inaccurate concept examples should, then, inhibit the efficient learning of concepts. In addition, experimental concept learning studies have shown that associating the critical properties and instances of concepts with the concept name or label increases the ease of subsequent concept attainment. This aspect of concept instruction is reflected in the adequacy of concept label coverage variable.

Semantic variables. The semantic aspect of an instruction event refers to the teacher's ability to convey meaning through appropriate choices of terminology. For this study, the semantic component was expanded to include syntactics, which deals with the rules governing word order.

As children progressively become able to perform formal operational thought processes, verbal language becomes increasingly more important as the medium of instruction. For children in grades three through five, verbal language itself is a major component of instruction. Semantic variables ought to play a critical role in the assessment of effective communication in instruction.

Three semantic variables were examined in this study.

(1) The teacher employs a balance of concrete and abstract terminology.

(2) The teacher speaks in complete, rather than incomplete, choppy sentences.

(3) The teacher uses pronouns which clearly refer to their antecedents.

Certain semantic abilities of the teacher could be identified as antecedent predictor variables to be examined in future studies. Abilities which logically relate to verbal performance during concept instruction might include such measures as verbal fluency and divergent production of classes.

Strategic variables. Instructional strategy refers to the total set of movements, or operations, performed by the teacher to achieve the instructional objectives. A strategy is comprised of smaller elements or purposive moves. A purposive move refers to an activity aimed at progressing the lesson from one substantive point to another. An utterance is a verbal expression performed by one person at a given time. An utterance may contain a single purposive move, or may contain several purposive moves. The specific purposive moves identified for this study were derived from instructional variables found to relate to concept attainment and from results of process-product investigations. The purposive strategic moves and the anticipated direction of their relationship with student achivement were:

(1) The teacher gives a concept definition. (positive)

(2) The teacher asks students to give a concept definition. (positive)

(3) The teacher gives a positive or negative concept example. (positive)

(4) The teacner asks students to give positive or negative concept examples. (pcsitive)

(5) The teacher reviews and summarizes the main ideas in the lesson. (positive)

(6) The teacher asks a low order question. A low order question prompts students to engage in recall or translation as cognitive processes. (positive)

(7) The teacher asks a high order question. A high order question requests students to engage in cognitive processes of comparison/contrast, analysis application, or evaluation. (null)

(8) The teacher changes or shifts the topic of the lesson. (null)

(a) The teacher signals a shift in the topic. (positive)

(b) The teacher employs a summary-signal-shift pattern. (positive)

(c) The teacher shifts the topic while asking a low order question. (negative)

(d) The teacher shifts the topic while asking a low order question. (negative)

(9) The teacher asks a pair of questions in a series, not allowing time for student response. (negative)

(10) The teacher answers his/her own or a student's question by explaining. (positive)

(11) The teacher repeats his/her own question, following a student's response. (negative)

(12) The teacher rephrases his/her own question, following a student's response. (negative)

(13) The teacher tells students to stop irrelevant behavior; or, the teacher engages in irrelevant behavior. (negative)

(14) Other behavior. Teacher's utterances which contained none of the above purposive moves were coded in this category.

Two additional strategic variables were added on the strength of results of several process-product studies.

(1) The teacher expresses enthusiasm and interest in the content of the lesson.

(2) The teacher displays an on-task approach toward the classroom atmosphere and its interactions.

Student Process Behaviors Examined

Select student behaviors occurring during instruction were measured by means of a low inference counting procedure. Two major types of student behaviors were examined: responses to teacher questions and initiating comments. Responses to the teacher's low or high order questions were coded as to the degree of "correctness" expressed, as compared to the body of knowledge presented (and implied) in the Instructions for Teachers manual. (These categories were correct; incorrect; logical - or a substantively "reasonable" statement, congruent with the general framework of the lesson, yet not directly related to the teacher's immediate question; and true. . .but - or a logical, substantively correct answer which was directly related to the teacher's immediate question, but was not accepted by the teacher.) Student responses to teacher requests for concept examples and definitions were coded as correct or incorrect.

In addition, four student initiating behaviors were examined. (1) The student expresses misunderstanding, requests repetition or clarification. (2) The student substantively challenges the teacher, overtly referring to a knowledge-related issue. (3) The student offers irrelevant, off-task talk, not

directly related to the development of the lesson and concerned with personal and/or organizational matters. (4) The student makes a contribution tangentially related to the lesson (usually known as "story-telling" amongst teachers.

(For details on instrumentation procedures and issues, see Armento, 1977 AERA paper.)

Results and Discussion

Student Behavior. None of the student behaviors related significantly with the criterion measure.

Table 1 here

However, each of the four variables representing student responses to teacher requests for concept examples and definitions was a positive correlate of student gain. This positive relationship between concept task-relevant student behaviors and student achievement was evident, despite the correctness or incorrectness of the student response. Thus, it appears that the more students are able to practice with and verbally manipulate the concept, the stronger is the student gain. Although the relationships are not strong enough to reach statistical significance, these variables are nevertheless promising enough to warrant further investigation in classroom settings.

Most studies which have examined the student response variable in experimental concept learning settings have found that the greater the involvement of the learner in the verbal and physical manipulation of the concept, the greater the ease of concept attainment (Clark, 1971). Studies of Kendler and Kendler (1961) and Milgram and Noce (1968) support the principle that students learn concepts with greater facility when they verbalize the critical properties of the concepts than if they do not engage in such verbalization. The basically Piagetian (1970) view that Taba (1966) reflects also supports the notion that knowledge results from a continual "acting upon", a transforming of the environment. During

classroom instruction, this dynamic notion of learning implies actively engaging students in the cognitive operations relevant to the task to be learned.

Two student initiated behaviors, expresses misunderstanding and challenges the teacher, related positively with student gain, while two others - off-task behavior and substantively digressing behavior - related negatively with the criterion measure. These relationships are at variance with previous process-product investigations which have found negative or low correlations between all types of student initiated behaviors and student achievement (Rosenshine, 1976).

The four student initiated behaviors examined in this investigation differ along the dimension of instructional relevance. The most instructionally relevant initiating behavior, off-task behavior, is also the strongest negative correlate of student achievement of any of the four initiating behaviors. Substantively digressing behavior can be placed next on the continuum of instructional relevance, as a negative correlate. The variable, expressing misunderstanding, asking for clarification or repetition, is a positive, although not significant, correlate of student achievement. This type of behavior may indeed be instructionally relevant: students must be interested and involved in the instructional tasks at hand in order to request specific help from the teacher to clarify misunderstandings. In order to substantively challenge a teacher's comments, a student would probably have to be deeply involved in the content of the learning tasks.

It is being suggested here that a range of student initiated behaviors may exist. One dimension along which they differ is that of their degree of instructional relevance. This dimension may be viewed as a psychological dimension of behavior, reflecting the degree of involvement in the learning tasks students demonstrate. The correlations support positive relationships between more instructionally relevant student initiating behaviors and student gain. Further investigation of the question of student initiated behaviors is warranted.

Teacher Behaviors. Five low-inference teacher variables related positively and significantly with the criterion measure.

Table 2 here

These behaviors are: the teacher --

(1) gives a concept definition;

(2) gives positive concept examples;

(3) reviews the main ideas of the lesson;

(4) explicitly includes more of the implied generalizations (or adequately covers the content);

(5) explicitly includes more of the relevant concept labels.

A discussion of each of the significant low-inference variables follows.

The teacher gives a concept definition (.43*). All concepts have attributes, and rules for defining the relationships among the attributes. A concept definition calls attention to the concept's relevant characteristics. This teacher behavior implies an expository, task-oriented approach in which the teacher makes known to students the relevant concept dimensions. The results of experimental investigations exploring task variables during concept attainment generally support the importance of giving concept definitions. Pointing out the critical properties, or the conceptual rule, tends to increase the ease of concept attainment more than permitting the subject to discover the rules (Clark, 1971). Concept definitions enable the learner to attend to the relevant dimensions of the concept. Opportunities for error and confusion are minimized as the learner is provided with accurate and adequate concept definitions.

The teacher gives a positive concept example (.50**). A positive concept example displays the critical properties of a concept in their appropriate relationship. The giving of positive instances is supported by experimental studies which generally find that the greater the proportion of positive instances, the

easier the concept attainment (Clark, 1971). In addition, as the number of examples increases, retention of the concept increases. The giving of positive concept examples is an on-task purposive component of concept instruction. An objective for initial concept learning is that the learner be able to cite or identify positive and negative concept examples. Thus, the inclusion of positive concept examples during direct instruction allows the learner to focus on content directly related to the goals of instruction.

The teacher reviews the main ideas of the lesson (.38*). A review (summarizing, restating, or rephrasing the main lesson ideas) serves to focus learner attention on critical aspects of instruction and serves to structure and reinforce major ideas of the lesson. The review variable has gained support as a viable teacher behavior in other process-product investigations. In studies by Fortune (1967) and Wright and Nuthall (1970), the teacher's reviewing of the main ideas was a positive correlate of achievement. Research findings on concept attainment also support the importance of review. Repetition of concept examples increases the ease of concept attainment. In addition, repetition and summarization of critical concept attributes serve to facilitate transfer to new instances of the same concept (Clark, 1971).

The teacher explicitly includes more of the relevant concept generalizations (.46**). The adequacy of content coverage variable was defined for this study as the number of essential generalizations which were explicitly stated by the teacher. A list of 15 relevant generalizations was derived from the instructional objectives for the two concept lessons. This set was viewed as the knowledge students needed to achieve the instructional goals.

The adequacy of content coverage variable was similar to the "student opportunity to learn the criterion material" variable of previous process-product investigations. Findings show that the correlations between measures of oppor-

tunity to learn and student gain have been positive and significant (Rosenshine and Furst, 1971). One might anticipate a strong relationship between the substantive aspect of instruction and student performance on tests emphasizing cognitive goals. How completely teachers deal with the knowledge component of instruction appears to be a significant aspect of teacher behavior worthy of further investigation.

The teacher explicitly includes more of the relevant concept labels (.53**). A second adequacy of the substantive aspect of instruction variable investigated in this study reflected the extent to which teachers explicitly stated the concept labels or names implied by the instructional objectives. Experimental concept learning studies have shown that associating the critical properties and instances of concepts with the concept name or label increases the ease of subsequent concept attainment (Clark, 1971).

Obviously, simply "saying" the name of the concept is insufficient. The label must be associated with the essential elements of the concept. The strategic variable correlates of the labeling variable included the following: the teacher --

(1) gives a concept definition (.63***);

(2) asks for a concept definition (.63***);

(3) gives a positive concept example (.47**);

(4) asks for a positive concept example (.39*);

(5) reviews the main ideas of the lesson (.54**)

(6) answers a question (.37).

These particular teacher purposive moves suggest ways in which a teacher may combine concept label usage with relevant concept instructional activities.

Each of the high-inference teacher process variables related in a positive direction to the student criterion measure. As shown in Table 3, four variables

were particularly strong: acuracy of concept examples, relevance of behavior to objectives, balance between concrete and abstract terminology, and enthusiasm/interest over the content of the lesson.

Accuracy of concept examples (.38*). The knowledge presented in the Instructions for Teachers manual was utilized as a standard against which the assessment of the accuracy of teacher-given concept examples was made. An important aspect of concept instruction is that the concept examples illustrate the critical dimensions of the concept. Experimental investigations on concept learning support the principle that as the critical properties of the concept become more obvious, ease of concept attainment increases (Clark, 1971). Inaccurate concept examples inhibit the efficient learning of concepts. Accuracy of knowledge a teacher presents during instruction appears to be a promising variable, worthy of further investigation.

Relevance of the teacher's behavior to the instructional objectives (.37*). Assessment of the relevance variable implied the need for a standard against which to judge behavior. The behaviors implied by the instructional objectives in this study were essentially cognitive in nature. Observers rated teachers on the degree to which behavior was task-focused. The more directly teachers addressed the instructional objectives, the higher the relevance rating. This on-task nature of the relevance variable is reflected in the negative correlation (-.51**) with actual counts of teacher off-task talk and with the positive correlation (.91**) with the low noise, on-task teacher behavior rating.

The relevance variable of this study shares characteristics with the "on-task" and "opportunity to learn the criterion material" variables which have correlated consistently with student gain (Rosenshine and Furst, 1971). In order to achieve concept learning outcomes, classroom tasks must be related directly to concept-relevant knowledge and processes.

The teacher maintains a balance of concrete-abstract terminology (.38*). As children progressively become able to perform formal, operational though processes, verbal language becomes increasingly more important as the medium of instruction. Making reality concrete becomes less necessary as students are more able to manipulate abstractions. However, for children ages 8-12, perhaps a balance of concrete and abstract terminology is necessary. A balance implies using concrete referents and definitions for abstract ideas. A proper balance between concrete and abstract terminology for upper elementary school students also implies introducing new, abstract concepts. For social science instruction, the fundamental concepts of the social sciences provide teachers with a framework of powerful, useful, and usually abstract ideas. These powerful concepts enable learners to derive generalizations which explain and predict reality.

The teacher expresses enthusiasm and interest over the content of the lesson (.48**). The enthusiasm variable in this study reflected the teacher's degree of "genuine" concern for the substance of the lesson and the extent to which the teacher appeared to convey to students the idea that the topic was exciting. Ratings on teacher enthusiasm have related consistently with student achievement in previous studies (Rosenshine and Furst, 1971). However, the low-inference behavioral correlates of teacher enthusiasm are still unknown.

The low-inference correlates of the rating on enthusiasm in this study imply the teacher's attention to the tasks of instruction. During concept instruction the enthusiastic teacher --

(1) gives concept definitions (.35*);

(2) asks for concept definitions (.20);

(3) gives positive concept examples (.66***);

(4) gives negative concept examples (.23);

(5) asks for positive concept examples (.46**).

The enthusiastic teacher also asks more high-order questions (.42*) than low-order questions (-.02) and also tends toward rephrasing (.46**) rather than repeating (-.29) a question.

Inverse relationships link the rating on teacher enthusiasm and the teacher's off-task (-.62***) and substantively digressing behavior (-.28). Thus, interest in the topic is expressed by the teacher's engaging in the relevant processes of instruction.

This study described teacher behaviors which were associated with greater gains in student learning of a social science concept. These associations have been utilized to form a basis for the generation of hypotheses which should be tested in subsequent experimental investigations. The following hypotheses are derived from the results of this study.

(1) As teacher behavior during concept instruction becomes more structured and task relevant, student learning will increase. That is, as teachers give more concept definitions, give positive concept examples, and review the main ideas of the lesson, student achievement of concept tasks will increase.

(2) As the substantive aspect of teacher behavior during concept instruction becomes more adequate, accurate, and relevant to the instructional objectives, student achievement on concept tasks will increase.

(3) As teachers include more of the relevant knowledge generalizations and more of the relevant concept labels during concept instruction, student concept learning will increase.

(4) As teachers express more enthusiasm and interest over the content of the concept lesson, student achievement will increase.

(5) As teachers ask more questions specifically requesting that students provide concept-relevant behaviors such as defining and exemplifying, student achievement on concept tasks will increase.

(6) As student involvement in concept-relevant tasks such as the giving of concept examples and definitions during instruction increases, student achievement on concept tasks will increase.

(7) As student task-relevant initiated behaviors increase during concept instruction, student achievement on concept tasks will increase.

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Figure 1
Observational System for Concept Instruction (OSCI)

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Teacher Behavior | Defining (·) (?) | | | | | | | | | | | | | | | | | | | | | D |
| | Examples (·) (?) (p,n) | | | | | | | | | | | | | | | | | | | | | E |
| | Signaling | | | | | | | | | | | | | | | | | | | | | S |
| | Reviewing | | | | | | | | | | | | | | | | | | | | | Rv |
| | Answering, Explaining | | | | | | | | | | | | | | | | | | | | | A |
| | Lower Order Question | | | | | | | | | | | | | | | | | | | | | L |
| | Higher Order Question | | | | | | | | | | | | | | | | | | | | | H |
| | Repeating | | | | | | | | | | | | | | | | | | | | | Rp |
| | Rephrasing | | | | | | | | | | | | | | | | | | | | | Rh |
| | Off-task | | | | | | | | | | | | | | | | | | | | | OT |
| | Other, Digression | | | | | | | | | | | | | | | | | | | | | O |
| | | | | | | | | | | | | | | | | | | | | | | |
| Student Behavior | Answer (C,L,T,I) | | | | | | | | | | | | | | | | | | | | | A |
| | Ex/Def (c,i) | | | | | | | | | | | | | | | | | | | | | ED |
| | Misunderstands | | | | | | | | | | | | | | | | | | | | | M |
| | Challenges | | | | | | | | | | | | | | | | | | | | | C |
| | Off-task | | | | | | | | | | | | | | | | | | | | | OT |
| | Other, Digression | | | | | | | | | | | | | | | | | | | | | O |

Symbols

Teacher Behavior:

· represents the teacher's giving of either a concept definition or a concept example.

? represents the teacher's asking for either a concept definition or a concept example.

p represents a positive concept example.

n represents a negative concept example.

Student Behavior:

In response to a teacher's low or high order question, (C,L,T,I) represent the following:

C is a correct response.
L is a logical response.
T is a true . . . but response.
I is an incorrect response.

c represents a correct concept example or definition.

i represents an incorrect concept example or definition.

Figure 2
Tally Form (Short Form for Data Collection)

Knowledge Components

Specialization is the concentration, focusing on a small aspect of some whole . . . . . _____

Specializing accentuates and creates differences . . . . . _____

Division of labor implies role differentiation . . . . . _____

Specialization occurs in at least three forms: technological, occupational, and geographical . . . . . t _____ o _____ g _____

Aim of specialization is efficiency . . . . _____

Specialization allows people and regions to use to best advantage their differences in skill, knowledge, interest, and resources . . p _____ r _____

Specialization necessitates interdependence . _____

Specialization necessitates trade . . . . _____

Specialization implies certain problems:

need for interdependence . . . . . _____

possible loss of efficiency in one area . _____

low transfer of specialized skills . . _____

possible boredom . . . . . _____

Concept Labels

Specialization . . . . . _____

Division of labor . . . . . _____

Technological specialization . . . . . _____
Occupational specialization . . . . . _____
Geographical specialization . . . . . _____

Interdependence . . . . . _____
Dependence . . . . . _____

Trade . . . . . _____
Exchange . . . . . _____

Figure 3
Generalizations Defining the Basic Knowledge
Implied by the Instructional Objectives

1. Specialization is the concentration or focusing upon some small aspect of a defined whole.

2. The process of specializing creates and accentuates differences.

3. Division of labor implies role differentiation.

4. Specialization occurs as the level of technology is differentiated to replace human resources.

5. Specialization occurs as human roles are differentiated in occupational endeavors.

6. Specialization occurs as geographical regions serve differentiated functions.

7. The major aim of any of the three forms of specialization is increased efficiency, or the production of more from fewer resources.

8. Specialization allows people to use to best advantage their differences in skill, knowledge, interest, and resources.

9. Specialization allows people to use regional differences in natural resources to best advantage.

10. Specialization necessitates interdependence.

11. Specialization necessitates exchange or trade.

12. Specialization implies the need for interdependence; this can be a problem.

13. When one specializes in one aspect of production, it is likely that one will lose efficiency in other areas of production.

14. There is often a low degree of transfer of specialized skills and capabilities from one aspect of production to another.

15. Certain repetitive specialized tasks often bring the problem of boredom.

Figure 4
Rating Form for Measurement of High Inference
Teacher Process Variables

Rating Code:

1 = very poor performance on this variable
2 = poor performance on this variable
3 = slightly below average on this variable
4 = average performance on this variable
5 = slightly above average on this variable
6 = good performance on this variable
7 = very good, outstanding performance on this variable

1. Accuracy of Concept-Specific Teacher Behavior

   a. Definitions given or developed by the teacher are accurate, correct.

   _____
   1 2 3 4 5 6 7

   b. Examples given or accepted by the teacher correctly represent the concept.

   _____
   1 2 3 4 5 6 7

   Sub-total--Accuracy _____

2. Relevance of Teacher Behavior to Instructional Objectives

   Teacher utterances are appropriate to the achievement of the instructional objectives for the lesson.

   _____
   1 2 3 4 5 6 7

   Sub-total--Relevance _____

3. Teacher Language

   a. The teacher uses a balance of abstract-concrete words.

   _____
   1 2 3 4 5 6 7

3. b. "Choppy utterances are minimal. Complete sentences are utilized.

_____
1 2 3 4 5 6 7

c. "Floating words" are minimal. The referent for a word is seldom in doubt; pronouns clearly refer to their antecedents.

_____
1 2 3 4 5 6 7

Sub-total--Semantics _____

4. The teacher expresses enthusiasm and interest in the content of the lesson.

_____
1 2 3 4 5 6 7

Sub-total--Enthusiasm _____

5. The teacher displays an on-task approach.

_____
1 2 3 4 5 6 7

Sub-total--On-task _____

TOTAL _____

Figure 5
An Example of Coded Teacher Strategic Behavior
Using the Observational System for Concept Instruction

| | ... | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| Defining (·) (?) | | | | · | | | | | |
| Examples (·) (?) (p,n) | | | | | p | p | p | | |
| Signaling | | | ⊙ | | | | | | |
| Reviewing | | · | | | | | | | |
| Answering | | | | | | | | | |
| Lower ? | | | | | | | | · | |
| Higher ? | | | | | | | | | |
| Repeating | | | | | | | | | |
| Rephrasing | | | | | | | | | |
| Off-task | | | | | | | | | |
| Other | | | | | | | | | |

In this example of coded teacher verbal behavior, the teacher reviews the major ideas already presented in lesson (2), signals a change in the topic (3), changes the topic (represented by the circle in #3), gives a concept definition (4), gives three positive concept examples (5,6,7), and then asks a low order question (8). All of the above purposive moves occurred in one utterance.

Figure 6
An Example of Coded Teacher-Student Process Behaviors
Using the Observational System for Concept Instruction

| | | ... | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| Teacher | Defining (·) (?) | | | | | | | | | |
| | Examples (·) (?) (p,n) | | ?/p | | | /p | | | | |
| | Signaling | | | | | | | | | |
| | Reviewing | | | | | | | | | |
| | Answering | | | | | | | | | |
| | Lower ? | | | | | | | | | |
| | Higher ? | | | | | | | | | |
| | Repeating | | | | | | | | | |
| | Rephrasing | | | | | | | | | |
| | Off-task | | | | | | | | | |
| | Other | | | | | | | | | |
| | | | | | | | | | | |
| Student | Answer (C, L, T, I) | | | | | | | | | |
| | Exam./Def. (c,i) | | | c/c | c/c | | | | | |
| | Misunderstands | | | | | | · | | | |
| | Challenges | | | | | | | | | |
| | Off-task | | | | | | | | | |
| | Other | | | | | | | | | |

The following teacher-student interaction is represented by the coding shown in Figure 6.

T: Can you name an example of occupational specialization that we haven't mentioned yet? (In move 2 the teacher asks for a positive concept example.)

S: My father works on the assembly line at RCA and specializes in installing tubes in color T.V. sets. (In 3, the student gives a correct concept example).

S: My big sister is studying to be a nurse. That's a specialized kind of job. (In 4, a student gives a correct concept example.)

T: Yes, you're both correct. Another example might be occupational therapists. (In 5, the teacher gives a positive concept example.)

S: I don't understand. What's that? (In 6, the student expresses misunderstanding.)

TABLE 1. PEARSON PRODUCT MOMENT CORRELATION COEFFICIENTS FOR STUDENT PROCESS VARIABLES AND STUDENT PRODUCT MEASURE (n = 22 classes)

| Student Process Variable | Correlation |
|---|---|
| Answers low or high order question correctly | -.221 |
| Gives answer which does not match teacher's question | .130 |
| Gives correct answer which teacher does not accept | -.278 |
| Gives incorrect answer | -.227 |
| Gives correct concept example | .209 |
| Gives incorrect concept example | .261 |
| Gives correct concept definition | .259 |
| Gives incorrect concept definition | .201 |
| Expresses misunderstanding, asks for clarification, repetition | .136 |
| Substantively challenges teacher | .311 |
| Offers irrelevant, off-task talk | -.211 |
| Makes a contribution tangentially related to lesson | -.033 |

Note: None of the student process variables related at a .05 level of significance with the student product measure.

TABLE 2. PEARSON PRODUCT MOMENT CORRELATION COEFFICIENTS FOR LOW INFERENCE TEACHER PROCESS VARIABLES AND CLASS RESIDUAL MEAN GAIN SCORES (n = 27)

| Teacher Process Variables | Correlation | Level of Significance |
|---|---|---|
| Gives concept definition | .426 | .02* |
| Asks for concept definition | .190 | |
| Gives positive concept example | .497 | .009** |
| Gives negative concept example | .225 | |
| Asks for positive concept example | .177 | |
| Asks for negative concept example | Does not occur | |
| Signals a topic change | -.008 | |
| Reviews, summarizes main ideas | .376 | .04* |
| Asks lower order questions | -.098 | |
| Asks higher order questions | -.047 | |
| Repeats question after student response | -.309 | |
| Rephrases question after student response | -.257 | |
| Signals and changes the topic simultaneously | -.171 | |
| Uses review-signal-shift pattern | .122 | |
| Changes topic with a low order question | -.301 | |
| Changes topic with a high order question | .162 | |
| Asks pairs of questions | -.013 | |
| Tells students to stop irrelevant behavior | -.050 | |
| Other, including substantive digressions | -.043 | |
| Adequacy of content coverage | .456 | .01** |
| Adequacy of concept label coverage | .528 | .006** |

*$p \leq .05$

**$p \leq .01$

TABLE 3. PEARSON PRODUCT MOMENT CORRELATION COEFFICIENTS FOR HIGH INFERENCE TEACHER PROCESS VARIABLES AND CLASS RESIDUAL MEAN GAIN SCORES

| Teacher Process Variables | Correlation | Level of Significance |
|---|---|---|
| Accuracy of concept definitions | .326 | |
| Accuracy of concept examples | .376 | .04* |
| Relevance of behavior to objectives | .370 | .04* |
| Balance between concrete and abstract terminology | .381 | .04* |
| Uses complete sentences and correct pronouns | .274 | |
| Expresses interest and enthusiasm over content of lesson | .478 | .01** |
| On-task, low noise behavior | .279 | |

*$p \leq .05$

**$p \leq .01$